Exploring the relative influence of knowledge, values and risk perception on engagement in climate change mitigation behaviors

Thesis

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By: Katherine Connolly

The Ohio State University

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Abstract

As one of the largest emitters of greenhouse gases in the world, the United States and its citizens will undoubtedly play a pivotal role in climate change mitigation. Yet, despite the scientific consensus on the topic, most Americans are not taking significant steps to address climate change. In order to understand this inaction and more effectively motivate individuals to change their behavior, it is important to examine the psychological processes related to engaging in climate change mitigation behaviors.

This study examined the relative influence of knowledge, values and risk perception on climate mitigation behaviors among Columbus, Ohio residents. As hypothesized, higher levels of knowledge regarding the causes and effects of climate change, strong self-transcendent values, and increased risk perception were all positively related to engagement in climate mitigation behaviors. Contrary to expectation, values were the single strongest predictor of behavioral engagement, followed by knowledge. Furthermore, risk perception was not a significant predictor of behavior nor did it strongly mediate the relationship between knowledge/values and behavior.

Overall, Columbus residents had only a moderate understanding of climate change, identified slightly more with self-transcendent values, as opposed to self-enhancement ones, and did not perceive climate change to pose a large personal risk. Based on these results, future climate change communication efforts in Columbus should emphasize the most significant causes of climate change, while also appealing to personal values. More research is needed to examine the influence of risk perception and why the variable did not perform as predicted.

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VITA

March 13, 1993…….Born, Rockville, Connecticut

Spring 2015 (Expected).....……B.S. Environmental Science
School of Environment and Natural Resources
The Ohio State University
Columbus, Ohio

FIELD OF STUDY

Major Field: Environmental Science

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1.1 Climate Change in the United States

There is an overwhelming scientific consensus that climate change is real, happening now, and caused by anthropogenic greenhouse gas (GHG) emissions (IPPC, 2013). The world is just beginning to see the impacts of climate change, which will only become more pronounced for future generations. Examples of these impacts include: loss of land due to rising sea levels, changes in the water cycle, increased incidence of extreme weather events, and ocean acidification, among several others (IPCC, 2013). With respect to the Midwestern United States in particular, scientists expect to see more frequent and severe heat waves, the spread of vector borne diseases (Lyme disease, Dengue fever, West Nile Virus), changes to water quality and quantity, and increased incidence of flooding (Pryor et al., 2014). When it comes to major emitters of greenhouse gases, the United States contributes a disproportionate amount to the atmosphere, emitting almost 20% of the world's total while constituting less than 5% of the world's population (U.S. Census Bureau, 2014; U.S. Environmental Protection Agency, 2013b).

In a national survey, the majority of Americans said they believe that both the private sector and the citizens themselves (67% and 63%, respectively) should be doing more to reduce greenhouse gas emissions and mitigate the effects of climate change (Leiserowitz et al., 2014b). However, this opinion is not reflected in the behavior of most Americans. A survey from 2013 found that only 46% of Americans conserve energy by keeping their thermostat at or below 68 degrees during the winter (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2014a). Furthermore, just 11% of respondents "often" or "always" walk, bike, use public transportation or carpool, rather than drive

(Leiserowitz et al., 2014a). Between 2011 and 2012, U.S. GHG emissions dropped by 3.4%, but this is still a 4.7% increase from 1990 levels (U.S. Environmental Protection Agency, 2014). While industry and the government will certainly need to make significant changes in order to decrease emissions, individuals will also play a pivotal role given that the residential sector accounts for one-fifth of the U.S.' carbon dioxide emissions (U.S. Energy Information Administration, 2015).

A good deal of research is now devoted to examining why climate change related behavior amongst the general public is so limited. In order to effectively address this question and encourage the necessary individual behavioral changes, scientists and policymakers need to understand which factors motivate and contribute to the adoption of certain behaviors. The behaviors of interest here are climate mitigation behaviors, which are actions that help to combat climate change, such as reduction of personal energy use (household, transportation) or political engagement in climate change issues.

An extensive body of research exists regarding the adoption of environmentally friendly behaviors, specifically in relation to climate change. Due to the fact that behavior is so complex, no single factor is likely to fully predict behavior. However, some factors have been found to influence behavior more than others. And while there are certainly many external factors (e.g., access, cost) that affect the adoption of climate mitigation behaviors, internal psychological factors play an extremely significant role. The factors that will be examined here are knowledge, values and risk perception.

1.2 Climate Change Knowledge and Behavior

Researchers and communicators often point to scientific illiteracy and public misunderstanding of climate science as reasons for climate change inaction, in what is

referred to as the knowledge-deficit model. While there are, undoubtedly, a number of people in the United States (16%) who do not "believe" in climate change, many Americans have at least a basic understanding of the subject (Leiserowitz et al., 2014b). According to a survey conducted through the Yale Project on Climate Change Communication, 57% of Americans understand the greenhouse gas (GHG) effect and 45% recognize carbon dioxide as a GHG (Leisorowitz, Smith & Marlon, 2010). However, while the majority of Americans believe that climate change is occurring, there is some confusion as to the causes (Leisorowitz et al., 2010). Exactly half of respondents understand the connection between climate change and human activities; however, this finding may be more a reflection of beliefs, which are heavily influenced by other factors like values and political ideology, as opposed to a measure of objective knowledge[1] (Wood & Vedlitz, 2007). Overall, the authors state that if Americans were to be graded on their climate change knowledge, only 8% would obtain an 'A' and 52% would receive a failing grade (Leisorowitz et al., 2010). These results indicate that most Americans have a very basic understanding of climate change, but are largely uneducated or misinformed when it comes to the specific details.

Despite what the public may or may not understand about climate change, scientists overwhelmingly agree that climate change is occurring as a result of human action. However, this level of consensus is not the case when it comes to scientific opinion on knowledge and behavior. Most studies have found that knowledge is not a very strong indicator of behavior, but others argue that knowledge can be a major determining factor (Kollmuss & Agyeman, 2002). Bord, O'Connor and Fisher (2000)

[1]While it impossible to have a truly objective measure of knowledge, for the purposes of this study 'objective knowledge' is a measure of an individual's ability to identify the scientifically determined causes and effects of climate change (i.e., correctly identifying fossil fuel combustion as a cause).

conducted a survey that assessed Americans' understanding of the causes of climate change by having them separate actual causes (cars, industry, fossil fuel usage, deforestation) from the "bogus" ones (aerosols, nuclear power, pesticides). They found that: "Accurate knowledge of global warming is the strongest single predictor of behavioral intentions" (Bord et al., 200, p. 215).

However, it is important to note here that intending to engage in a behavior is not the same thing as actually doing something. It may be that knowledge is critical to explaining intentions, but that when it comes to actual behavior, knowledge becomes less critical and other factors come into play. Yet, in their 2008 study in Portland, Oregon, Semenza et al. found that simply being aware of climate change was positively correlated with actual behaviors; the majority of respondents who said that they had previously heard about climate change had, in fact, altered their behavior. However, it is necessary to point out here that the authors were not entirely clear about what measures they used (e.g., actual knowledge, awareness, or self-reported knowledge). The vagueness of this measure is indicative of the overall body of literature regarding knowledge and behavior because there is much disagreement over the importance of knowledge and studies often use very different measures that make it difficult to draw conclusions. So while Semenza et al. (2008) may have found a relationship between awareness and behavior, it is unclear as to whether this finding can serve as an indication of the effect of objective knowledge. Furthermore, this study identified a correlation but did not assess causation and several other factors could have influenced whether study participants adopted certain behaviors.

Additional evidence suggests the effects of knowledge on behavior may be mediated by other higher order cognitions or beliefs, such as risk perception. If this is the case, that would make the influence of knowledge indirect, as opposed to direct. For example, in his 2012 study, Taciano Milfront found that concern about climate change mediated the relationship between self-reported knowledge (how well-informed the individual feels he/she is about climate change) and self-efficacy. Self-efficacy refers to whether an individual thinks he/she is able to perform a specific behavior and/or reach a goal, and is an important prerequisite for engaging in actual behavior (Milfront, 2012). Also, some studies have found that the effect of knowledge is often mediated (or cancelled out) by political orientation. For instance, McCright and Dunlap (2011) analyzed a decade's worth of Gallup Poll data and found that higher self-reported knowledge corresponded with a greater belief that climate change is happening in liberals and moderates, but much less so with conservatives. Therefore, increased knowledge may not even change climate change beliefs, much less behavior. However, this does not mean that knowledge is unimportant or that information campaigns are ineffective.

In their 2008 study, Semenza et al. examined the reasons why some of the respondents did not engage in pro-environmental behaviors. The most commonly cited reason for not adopting pro-environmental behaviors was that the individual simply did not know how to do so, meaning they have low self-efficacy (Semenza et al., 2008). This suggests that lack of knowledge regarding possible climate change mitigation behaviors can lead to low self-efficacy and act as a barrier to behavior change. However, simply providing people with information on climate change and pro-environmental behaviors will most likely not cause them to adopt mitigation behaviors, especially if the

information provided conflicts with their existing values (Whitmarsh, Seyfang & O'Neil, 2011).

Many studies support the relatively weak and/or indirect influence of knowledge on behavior. This weak relationship is partially the result of the "knowledge-action gap" (Ortega-Egea, Garcia-de-Frutos & Antolin-Lopez, 2014), which means that a person may know the basic causes and effects of an issue (like climate change), yet does not change his/her behavior accordingly. For example, one study found that even though 90% of people know how greatly transportation contributes to climate change, only about a third of respondents changed their driving/flying behavior as a result (Whitmarsh et al., 2011).

The reason for this knowledge-action gap is likely because the effect of knowledge is relatively far removed from behavior with other, more influential, factors mediating the relationship. For instance, Mobley, Vagais and DeWard (2010) looked at the effect of reading environmental literature on behavior (where the literature provided information about environmental issues, thereby increasing knowledge). They found that while reading environmental literature was a good predictor of environmental behavior, environmental concern was an even stronger predictor. This points to the mediating role of environmental concern, where knowledge increases concern, and concern increases the likelihood of behavior engagement.

Taken as a whole, the body of literature indicates that climate change knowledge is important, but cannot fully explain climate mitigation behaviors. Knowledge is more likely to influence behavior indirectly through its effect on attitudes, beliefs and/or concern. Additionally, not all types of knowledge will play an equal role; knowledge of the causes and impacts of climate change, as well as an understanding of adaptation

and/or mitigation behaviors tend to be most critical. Conversely, incomplete or inaccurate knowledge can act as a significant barrier to action. However, research indicates that there are more impactful psychological barriers within the context of climate mitigation behaviors.

1.3 Personal Values and Behavior

Values are one factor that may be more influential than knowledge with regards to behavior. Philosophers, economists and psychologists alike have all studied and attempted to define value. While there are a number of definitions that exist, for the purposes of this paper value is defined as, "(a) concepts or beliefs, (b) about desirable end states or behaviors, (c) that transcend specific situations, (d) guide selection or evaluation of behavior and events, and (e) are ordered by relative importance" (Schwartz & Bilsky, 1987, quoted in Manfredo, 2008, p.147).

There are also many different ways in which researchers categorize values, but Shalom Schwartz developed one of the most common typologies with respect to environmental psychology. Schwartz conducted hundreds of surveys over several decades in dozens of countries and found similar value types to exist across and within cultures. Using the data from his surveys, Schwartz created a list of ten values, which he simplified into two broad value dimensions (Manfredo, 2008). The first dimension ranges from self-transcendent to self-enhancement values. People who fall closer to the self-transcendent side of the spectrum tend to place the needs of others (which could include animals and the environment) before their own, while self-enhancement values are typically associated with people who are more motivated by self-interest (Dietz, Fitzgerald, & Shwom, 2005). The second value dimension ranges from "conservation"

(or traditionalism), which characterizes individuals who wish to maintain tradition and the status quo, to "openness to change." People who identify with "openness to change" values tend to place a high importance on pursuing one's emotional and intellectual passions, regardless of the status quo.

These value dimensions are relevant to climate change mitigation behaviors because research has found that values have an indirect, yet significant, influence on behavior (Vaske & Donnelly, 1999). For instance, research has found that self-transcendence values tend to be positively correlated with engaging in pro-environmental behaviors, while conservation and self-enhancement values are negatively correlated (Dietz et al., 2005; Karp, 1996). Studies have also found a link between values and policy preferences. Individuals with more egalitarian and self-transcendent values show greater support for international and domestic climate change policies than people with strong self-interest values (Leiserowitz, 2006).

Research has also shown that values are related to environmental concern and acceptance of global warming. A 2009 study found that the American public falls into six major groups in terms of how they react to climate change (Maibach, Roser-Renouf, & Leiserowitz, 2013). Individuals in "the Alarmed" group, which characterizes those who believe that climate change is serious and are acting to combat it (18% of Americans), tend to have strong egalitarian values (similar to self-transcendent values) and place a greater importance on the environment than on economic growth. At the other end of the spectrum is "the Dismissive" group, which makes up 7% of the American public and consists of people who strongly believe that global warming is not happening and

actively oppose measures to address it. People in this group tend to have strong individualist values and tend to be anti-egalitarian (Maibach et al., 2009)

As mentioned earlier, the influence of values on behavior is theorized to be indirect, with other factors playing a more direct role. McCarty and Shrum (2001) found that belief about the importance of recycling mediated the influence of values on actual recycling behavior. People in the study with collectivist (self-transcendent) values were more likely to view recycling as important. Having the belief that recycling is important was positively correlated with recycling behavior, whereas the relationship between collectivist values and behavior was not as strong (McCarty & Shrum, 2001). In contrast, individualists (related to self-enhancement values) are more likely to believe that recycling is unimportant and this belief is negatively related to recycling behavior (McCarty & Shrum, 2001).

While values can be a good indicator of environmentally related behaviors, values alone do not determine behavior (Whitmarsh, 2008). Many studies have found that there is often a large disconnect between values and behavior, called the "value-action gap" (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007, p. 447). In fact, many people act in a way that seemingly contradicts their values. This failure of values to translate into behavior can result from barriers, both perceived and real, to behavior change (Lorenzoni et al., 2007). Consequently, values are often, though not always, correlated with behavior.

1.4 Risk Perception Toward Climate Change

Few would disagree with the statement that 'fear can be a powerful motivator.' This is an idea that is explored not only in literature and film, but also in scientific research. From a psychological perspective, fear is closely linked with the concepts of

risk and risk perception. While "risk" is a frequently used word with many connotations, it is taken here to mean "the probability that exposure to hazard will lead to a negative consequence" (Ropeik & Gary, 2002, p. 4). Risk perception refers to the way in which an individual perceives and evaluates said risk.

The existing body of literature points to risk perception as a fairly good predictor of individual behavior. According to Semenza et al. (2008), voluntary reduction in energy consumption depends upon an individual's awareness *and* concern regarding climate change. Concern about climate change is strongly influenced by an individual's risk perception of climate change. High-risk perception toward climate change tends to lead to more behavior change in response. According to Whitmarsh (2008), the "perceived societal risk of global warming moderates the relationship between knowledge and behavioral intentions to address global warming" (p. 15). Therefore, risk perception may be the linking factor in the knowledge-action and/or value-action gap.

Public perception of climate change risk is especially important because politicians often pay attention to the issues that concern the public and this can help determine policy priorities in government. Consequently, numerous surveys are conducted to examine Americans' perceptions toward climate change. In a March 2014 Gallup Poll, Americans were asked how greatly they worried about a variety of different topics (Riffkin). Of the 15 issues listed, climate change ranked 14th, just above race relations, with only 24% of Americans worrying a "great deal" about it and 51% worrying "a little/not at all." For the sake of comparison, 59% of Americans reportedly worry a great deal about the economy (the item with the greatest concern). Furthermore, another Gallup survey from the same month found that only 36% of Americans think

climate change will “pose a serious threat to their way of life during their lifetimes” (Jones, 2014). These findings indicate that Americans do not perceive climate change to pose a high personal risk, which is inconsistent with the expert assessment of climate change risk. The reason for this difference has to do with a number of psychological factors.

When people are asked to rank a number of hazards according to the risk they think it poses, they often take many factors into account and may not even consider hard scientific data. Due to the potentially heavy influence of risk perception on behavior, it is important to understand why the public perceives certain hazards, like nuclear meltdown, to be high risk and others, like climate change, to be relatively low risk. Research indicates that people tend to perceive something as higher risk when they are unfamiliar with the hazard and/or do not understand it, such as with a new technology (Gardner, 2008). Catastrophic potential also increases risk perception, which is why the public tends to rank nuclear power as a bigger risk than it actually is. It is also worth noting here that certain sociodemographic variables are linked to risk perception; women tend to have higher perceptions of risk than men, especially where human health and safety are involved (Slovic, 1999). Higher education and income levels also tend to be associated with lower risk perception and white men typically have the lowest levels of perceived risk, which is referred to as the White-male effect (Slovic, 1999).

In contrast, factors that are associated with increased risk perception include: if the risk is imposed involuntarily, low level of self-control over the risk, risks with extensive media coverage, identifiable victims (especially children) involved, irreversibility, and immediate threat/impacts (Gardner, 2008). Looking at the these

factors gives an indication as to why climate change is often seen as relatively low risk in the eyes of the American public. Even though climate change does have potentially catastrophic consequences, the changes are rather slow and imperceptible to most humans, making the threat seem much less immediate. Furthermore, there is a lack of identifiable victims and inconsistent media coverage that often misrepresents the issue of climate change, especially with respect to the scientific consensus. Overall, the average person tends to perceive climate change as a spatially and temporally distant threat that will mainly affect wildlife or generations far into the future (Lorenzoni et al., 2007). When an individual does not perceive a risk as posing a personal threat, then he or she is less likely to be motivated to take action.

For instance, a 2012 study conducted by Spence, Poortinga and Pidgeon found that psychological distance of climate change (how far away an individual perceives the impacts of climate change to be in terms of time, geography and society/culture) was negatively related to both concern about climate change and willingness to act. Conversely, people who thought that the impacts of climate change would occur in their area in the near future and affect people similar to them (i.e. they perceived climate change as psychologically near), reported much higher levels of willingness to act to address climate change (Spence et al., 2012). The authors also found that concern about climate change had the single strongest relationship with willingness to act (Spence et al., 2012). Therefore, the psychological distance of the impacts of climate change may also help to account for Americans' relatively low levels of concern.

Another relevant factor is the inverse relationship between risk perception and perception of benefits to people (McDaniels, Axelrod & Slovic, 1996). For instance, a

person may view cheap gas prices as financially beneficial, which would make them less likely to perceive the greenhouse gas emissions from that consumption as harmful. Furthermore, McDaniels et al. (1996) found that people often see consequences, like climate change and species loss, as high risk, but do not ascribe the same level of risk to the causes (automobiles, energy production). It may be that people struggle to make the connection between the riskiness of the causes and effects because they see their daily activities (driving, heating/cooling homes) as acceptable while things such as climate change and species loss are not (McDaniels et al., 1996). Understanding this connection would force people to realize their own personal contribution to climate change, which can be an uncomfortable reality.

This is not to suggest that everyone in the United States completely disregards the risks posed by climate change. And for those who do have higher risk perceptions, it can be a good motivator for behavior change. For instance, a study conducted in Phoenix, Arizona found that an individual's perceived risk, specifically in relation to heat waves, was the single strongest predictor as to whether he/she would engage in adaptive behaviors (Kalkstein & Sheridan, 2007). Additionally, in the Semenza et al. (2008) study "individuals at each increase in level of concern were 30-40% more likely" to take climate change mitigation actions.

Similar to knowledge and values discussed above, risk perception alone is unlikely to determine behavior. People need to not only know what behaviors are effective at mitigating perceived risks, but also believe that they are capable of engaging in said behaviors in a way that is consistent with their values. Therefore, knowledge, values and risk perception all play a role in behavior, though not necessarily at the same

time or to equal extents. This study aims to determine which of these three factors is most significantly related to engagement in environmentally friendly behavior and assess how the three variables interact. While there is already a great deal of literature devoted to this topic, much of it measures behavioral intentions or uses other proxy measures for behavior (efficacy, willingness to act). Behavioral intentions can be a useful indicator of behavior, but measuring the self-reported behavior itself is far more accurate, which is the method used in the study here. Specifically, the purpose of this study is to assess Columbus residents' level of knowledge regarding climate change and to better understand the psychological factors influencing the adoption of climate mitigation behaviors.

Chapter 2: Climate change in the mind of the Columbus resident

2.1 Introduction

Despite the fact that a majority of Americans (55%) are at least somewhat concerned about climate change, the United States is still one of the largest emitters of climate change-causing greenhouse gases (GHGs), only recently being surpassed by China as the world's number one emitter (Leiserowitz et al., 2014b; World Resources Institute, 2014). A small portion of the American public has started to rally around the cause with just over 300,000 people turning out for the People's Climate March in New York City during September of 2014 (Foderaro, 2014). But, in a country of 320 million, much more support will be needed to make any significant changes to overall emissions (U.S. Census Bureau, 2015). Given the need for more widespread support, it is essential to understand why certain people engage in environmentally friendly behaviors and others do not.

Factors such as cost and access are obvious barriers to behavior change, but the influence of internal factors is much less clear-cut. Consequently, a great deal of psychological research has been devoted to studying what most affects behavior, specifically within the context of climate change. Scientists typically agree that knowledge, values and risk perception all influence behavior, but the importance of each variable is a topic of much debate (Dietz et al., 2005; Kollmuss & Agyeman, 2002; Semenza et al., 2008). For instance, certain types of knowledge, specifically accurate knowledge of the causes and effects of climate change, are more critical than other types of knowledge when it comes to behavior change (Bord et al., 2000). However, increasing knowledge through exposure to information is often not enough to facilitate behavior

change because its influence is indirect with other higher order cognitions (beliefs, risk perception) mediating the relationship between knowledge and behavior (Whitmarsh et al., 2011).

Furthermore, people often filter out new information when it conflicts with their existing ideologies and/or values, which can lessen the impact of increased knowledge (Wood & Vedlitz, 2007). Consequently, values are another important factor to consider with regards to climate change behavior. Values are "(a) concepts or beliefs, (b) about desirable end states or behaviors, (c) that transcend specific situations, (d) guide selection or evaluation of behavior and events, and (e) are ordered by relative importance" (Schwartz & Bilsky, 1987, quoted in Manfredo, 2008, p.147). Researchers often classify people according to two main value dimensions: self-enhancement to self-transcendence and conservation to openness to change (Manfredo, 2008). Studies have found that individuals with strong self-transcendent values, meaning they tend to place others' needs before their own, often perceive the environment and its protection as more important than those with self-enhancement values. They are also more likely to engage in environmentally friendly behaviors (Dietz et al., 2005; McCarty & Shrum, 2001; Whitmarsh, 2008). However, people often act in a way that is inconsistent with their values, a situation known as the value-action gap, because a value's influence on behavior is indirect and numerous barriers, both perceived and real, can interfere with the adoption of particular behaviors (Lorenzoni et al., 2007).

The third and final factor examined here is that of risk perception, which is thought to have a more direct impact on behavior. Risk is "the probability that exposure to hazard will lead to a negative consequence," while risk perception refers to the way in

which an individual perceives and evaluates said risk (Ropeik & Gary, 2002, p.4). Risk perception can be a powerful incentive for behavior change because individuals usually act in a way that they think will lessen the potential for harm. With respect to climate change, research has found that individuals who perceive climate change to be high risk are more likely to engage in adaptation and mitigation actions (Kalkstein & Sheridan, 2007; Semenza et al., 2008). Yet, risk perception in the United States is relatively low, largely because people perceive climate change to be a spatially and temporally distant threat (Lorenzoni et al., 2007).

While the average U.S. citizen may not think of climate change as a serious threat, many governments around the world are starting to prepare for its impacts. Within the U.S., a lot of the most meaningful action with respect to climate change has taken place at the state and local level. For example, Columbus, Ohio is working to create a climate change adaptation and mitigation plan, as well as develop communication efforts to inform citizens and encourage environmentally friendly behaviors. In order to do so, city officials need to know what Columbus residents think about climate change, what behaviors they engage in, factors affecting said engagement, and what support, if any, exists for climate policies. The city's desire for this information eventually led to a collaboration between individuals at The Ohio State University's School of Environment and Natural Resources and the city of Columbus's Public Health department.

The study reported here used data collected as part of this collaborative project in order to gain a better understanding of climate change in the mind of the average Columbus resident. More specifically, it aimed to accomplish two main objectives:

- To assess the average Columbus resident's level of knowledge regarding the causes and effects of climate change
- To investigate the relative effect of knowledge, values and risk perception on the adoption of climate mitigation behaviors

2.2 Methods

Members of the Environmental and Social Sustainability Lab within the Ohio State University's School of Environmental and Natural Resources worked with Columbus Public Health and the Mayor of Columbus's Office of Sustainability to develop an online survey. Questions on the survey covered a variety of topics, including: beliefs, personal relevance of climate change, risk perception, behavioral intentions and motivations, support for policy, socio-demographics, and so on. The survey was distributed via e-mail January 31 through February 10, 2014 to a representative sample of Columbus residents using the online survey software Qualtrics. A panel of respondents was purchased for $4,400 through Qualtrics and those who received the survey had previously volunteered to receive such solicitation via e-mail. Using the panel allowed us to obtain both a representative sample and ensure our minimum number of completed responses needed to accurately represent the population (n = 400). A one dollar incentive was offered to those who completed the survey and 402 (88%) of the 455 people who began the survey, completed at least 70% of it.

2.3 Survey Measures

For the purpose of this study, I focused on the survey measures that specifically related to climate mitigation behaviors, climate change knowledge, environmental values, and risk perception toward climate change. Certain sociodemographic variables (see Table 1) were also included in the logistic regression analysis to control for five other factors that may significantly influence behavior.

Table 1: Survey Measures

Measure	Item
Behavior[a]	Using cold water in place of hot or warm water when washing clothes Contact my state representative about addressing climate change Drive less often when public transportation, walking, biking or other alternatives are available
Values[b]	Protecting the environment, preserving nature Fitting into nature, unity with nature Respecting the earth, harmony with other species
Risk Perception[c]	How vulnerable do you feel to the effects of climate change? How severe do you think the effects of climate change are/will be for you personally?
Socio-demographics	Gender[d] Age[e] Highest level of education[f] Approximate annual household income[g] Political orientation[h]

[a] Measured on a scale from 0 = not doing this to 1 = already doing this
[b]Measured on a 4-point scale from 0= not at all [important] to 4=very important
[c]Measured on a 5-point scale from 1=not at all severe/vulnerable to 5=extremely severe/vulnerable
[d]Measured on a scale from 1= male to 2= female
[e]Measured as an open-ended text input question
[f]Measured on a scale from 1= Less than high school to 8 = Doctoral degree
[g]Measured on a scale from 1 = Less than $10,000 6 = $100,000 or more
[h]Measured on a scale from 1 = Very liberal to 6 = Very conservative

Behavior was measured by asking respondents how likely they were to engage in each of three listed behaviors (Table 1). However, they also had the option to select "I already do this." This study looked at behavior, rather than behavioral intentions, so we were concerned with whether or not the respondent actually engaged in climate mitigation behavior. Behavior was treated as a categorical variable so if an individual had not already engaged in any of the behaviors then he/she was assigned a value of 0 and any individual who already engaged in one or more of the three behaviors was assigned a value of 1. This behavioral measure was the main dependent variable in the analyses.

Three questions were included as part of the climate change knowledge measurement (specifically probing the causes and effects of climate change, see Table 2). Respondents received 1 point for each knowledge question that was answered correctly, meaning that they identified the response that is most consistent with scientific evidence. For the multi-part question that asked respondents to identify the causes of climate change, respondents received 1 point for every correct cause they selected and lost one point for every incorrect cause they selected. For the question about the impacts of climate change, respondents received 1 point for each of the 6 potential impacts they selected (all are 'correct answers'). There was also an option to select '\"none of these because climate change is not happening", but this response was not included as part of the analysis. The final measure of knowledge was treated as a continuous variable, computed by adding the total number of correct responses across the three questions ranging from -4 to 11 with higher scores corresponding to a greater level of knowledge.

Table 2: Knowledge Measure[a]

Item	Scale
The greenhouse effect refers to…	Measured from 0 = incorrect answer (Pollution that causes acid rain, The earth's protective ozone layer, How plants grow, or I'm not sure) to 1= correct answer (Gases in the atmosphere that trap heat)
Which of the following, if any, contribute to climate change (select all the apply)	Measured on a scale from -4= selecting all the incorrect causes[b] and no correct[c] causes to 4= selecting all correct causes and no incorrect ones
Which of the following do you expect to be impacted in Ohio as a result of climate change (select all that apply)	Measured from 0=selecting none of the impacts[d] to 6=selecting all of the impacts[e]

[a]Measured on a 16-point scale from -4= very low level of knowledge to 11=high level of knowledge.
[b]Incorrect causes (-1 each) included: aerosol spray cans, hole in the ozone layer, toxic waste, nuclear power plants.
[c]Correct causes (value of 1 each) included: cutting down forests, cows and other livestock, powering cars and trucks, burning fossil fuels.
[d]Impacts included: temperature, annual precipitation, snow precipitation, crop yields, extreme weather events, human health and safety

There survey included three questions (see Table 1) relating to environmental values adapted from Stern, Guagnano and Dietz (1998). The statements were meant to measure the strength of the four higher order value clusters (self-transcendence, self-enhancement, openness to change and conservation). Respondents were asked to rate the importance of each of three statements pertaining to environmental values, ranging on a scale from 0 for "not at all" to 4 for "very important." The responses for each question were added and averaged (divided by 3) to give each person a "value score" (continuous variable) to compare to the behavior score. Higher scores indicate that the person held stronger environmental/self-transcendent values, whereas lower scores indicate weak environmental values (i.e., more self-enhancement values).

There were 2 questions measuring risk perception, looking at both one's perceived vulnerability to the effects of climate change and one's perception of the

severity of the effects from potential impacts (see Table 1). Individuals with the lowest level of perceived risk were assigned a value of 1 and the highest level of perceived risk corresponded to a value of 5. The values for the severity item and the vulnerability item (both 1-5) were then multiplied to give a total risk score, which was treated as a continuous variable. Higher values indicate a higher level of perceived risk.

2.4 Hypotheses

With the objectives and existing research as a guide, five hypotheses were developed for the project.

- H1: *Knowledge of the causes and effects of climate change is positively correlated with engaging in climate mitigation behaviors.* This means that a person who understands the causes and effects of climate change will be more likely to engage in the tested behaviors.
- H2: *Pro-environmental values are positively correlated with engaging in climate mitigation behaviors.* Therefore, an individual who rates environmental values as more important (i.e. has stronger self-transcendent values) will be more likely to engage in the tested behaviors.
- H3: *Climate change risk perception is positively correlated with engaging in mitigation behaviors.* So, if a person perceives climate change as something that is likely to cause him/her harm, then he/she will be more likely to engage in the mitigation behaviors.
- H4: *Risk perception will have the greatest positive effect on engaging in climate mitigation behavior*. Consequently, the highest positive correlation (and effect

size) will be found between risk perception and behavior (compared to knowledge/values and behavior).

- H5: *Risk perception will partially mediate the effect of knowledge and values on behavior.* As a result, the indirect effect of values and knowledge on behavior, as mediated through risk perception, will be greater than their direct effect.

2.5 Analyses

I used Cronbach's alpha to assess the reliability of the measures discussed above, and descriptive statistics as well as bivariate correlations to assess the initial relationships and hypotheses. I used logistic regression to assess the overall model fit where knowledge, values and risk perception serve as predictors of climate change mitigation behaviors, while controlling for five sociodemographic factors. This method also allows me to assess the individual effect of each independent variable on behavior. The PROCESS procedure (written by Andrew F. Hayes for SPSS) was used to assess the mediating effect of risk perception on the relationship between knowledge and behavior, as well as values and behavior (Hayes, 2014). I conducted all of the above-mentioned analyses in the Statistical Package for the Social Sciences (SPSS).

2.6 Results

2.6a Descriptive Results

Based on the available data, 362 of the 402 respondent (90%) were included in the analyses; any individual who did not answer one or more of the survey questions used in these analyses was excluded due to the missing data. Of the 362 individuals included, 52.2% were male and 47.8% were female, which is fairly close to the actual gender distribution in Columbus of 48.8% male and 51.2% female (United States Census

Bureau, 2014). The breakdown of respondents according to ethnicity was as follows: 85.5% Caucasian, 8.6% Black or African American, 6.6% Asian and 1.4% Hispanic/Latino (respondents had the option to identify as more than one ethnicity). Caucasians were overrepresented in the sample as compared to the Columbus population, which is 61.5% Caucasian, 28% Black or African American, 4.6% Asian and 5.6% Hispanic or Latino (United States Census Bureau, 2014). As for political orientation, the majority (56.6%) of respondents considered themselves to be moderate (27.9% liberal-leaning, 28.7% conservative leaning), 19.9% liberal (4.4% of whom were 'very liberal') and 23.4% conservative (4.1% 'very conservative').

84.8% of respondents had obtained some education past high school: 28.2% had some college, business or technical school experience, 6.9% had an Associate's degrees, 27.6% with a Bachelor's degrees, 14.1% with a Master's degree and 8% with a professional or doctoral degree. Only 1.7% of participants had less than a high school education and 13.5% had graduated high school or obtained a GED. This sample had an overall higher level of education than the Columbus population as a whole; 33.1% of Columbus residents have a bachelor's degree or higher (49.7% in the sample) and 11.7% of people did not graduate high school (United States Census Bureau, 2014). The age of participants ranged from 18 to 83 with an average age of 50.65 years. In comparison to the population of Columbus, in which 8.6% of people are over the age of 65, this sample is older with 24.4% of respondents 65+ years old (United States Census Bureau, 2014). Table 2 below shows a breakdown of age by decade and Table 3 shows the breakdown of the household income of participants.

Table 2: Age of Respondents

Age Range	% of respondents
18-29	13.8
30-39	14.4
40-49	16.8
50-59	20.5
60-69	22.3
70-79	11.6
80-83	0.6

Table 3: Income of Respondents

Household Income	% of respondents
Less than $10,000	3
$10,000-29,999	8
$30,000-49,999	22.9
$50,000-74,999	21.5
$75,000-99,999	19.9
More than $100,000	24.6

The majority (58.3%) of individuals included in this analysis engaged in at least one of the three mitigation behaviors. The most common behavior for people to "already do" was use cold water when washing clothes (51.9%), which helps to reduce household energy use. Only a very small portion (2.5%) of participants said that they had contacted a government representative about a climate change related issue at some point before taking the survey. Nearly one-fifth (19.9%) of the sample already drove less often.

As for values (table 4), the average score was a 2.6 on a scale from 0-4, which indicates that the average participant leaned more towards self-transcendent values, as opposed to self-enhancement ones. 15% of respondents held very strong environmental values (score of 4), while 9.4% had very weak environmental values (0-1).

Table 4: Values

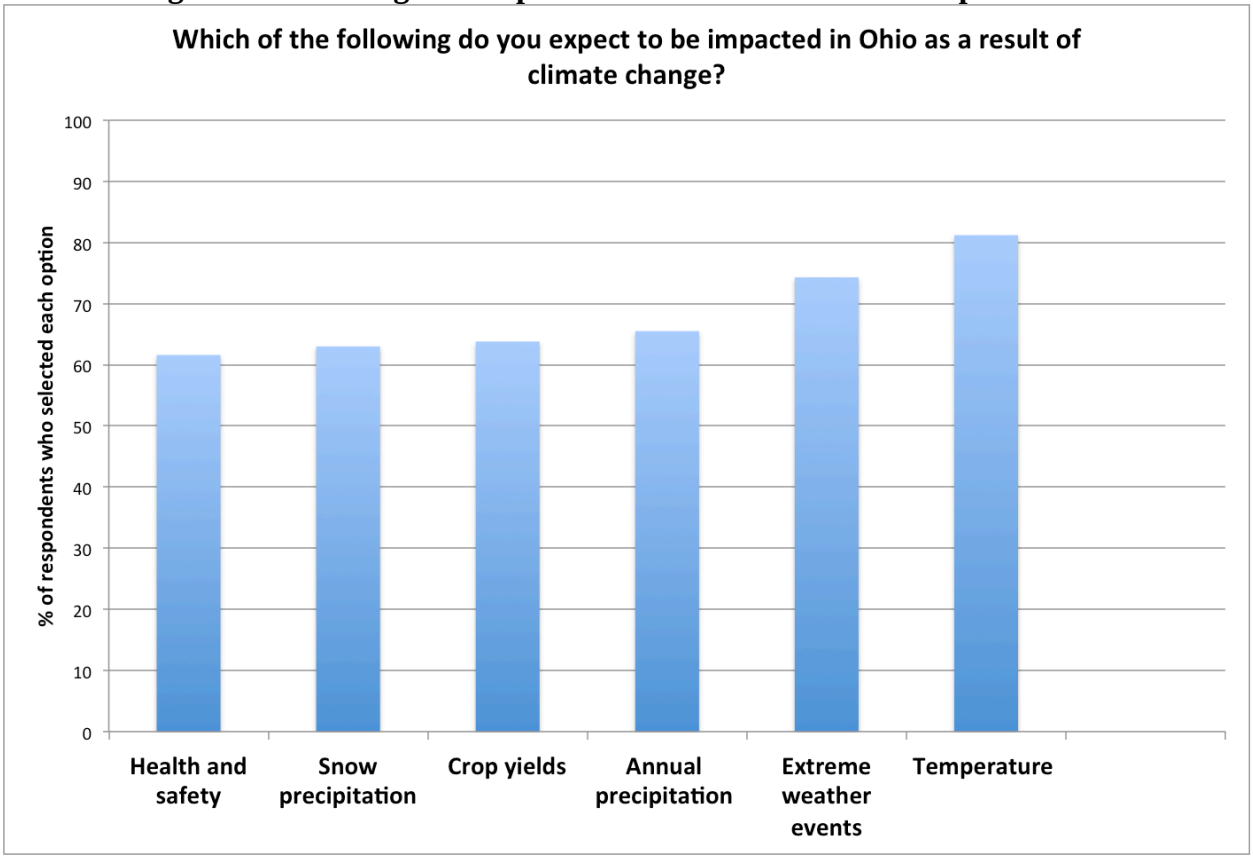
Environmental Values Strength (score)	Percentage of Respondents
Weak (0-1.0)	9.4
Weak-Moderate (1.3-2.0)	25.7
Moderate-Strong (2.3-3.0)	37.3
Strong (3.3-4)	27.6

With respect to climate change knowledge, the majority of respondents had at least a moderate level of knowledge (a score of 4-7 on a scale from -4 to 11, see Table 5) and the average score was a 4.96. Only 1.1% obtained the maximum possible knowledge score of 11, which required that the individual correctly define greenhouse gases (1 point), select all of the listed impacts (6 pts) and only chose the *correct* causes (4 pts) of climate change. Looking at the individual knowledge items, two-thirds of all respondents were able to select the correct definition of greenhouse gases and all but 10.8% were able to correctly identify at least one potential impact of climate change in Ohio. Overall, there seems to be a fairly good understanding of the expected impacts of climate change with the least-selected impact (human health and safety) still being chosen by 61.6% (Figure 1) and over 80% of people identifying temperature change as an impact.

Table 5: Knowledge

Knowledge (Score)	Percentage of Respondents
Very low (-4 to -1)	1.7
Low (0-3)	29
Moderate (4-7)	51.9
High (8-11)	17.4

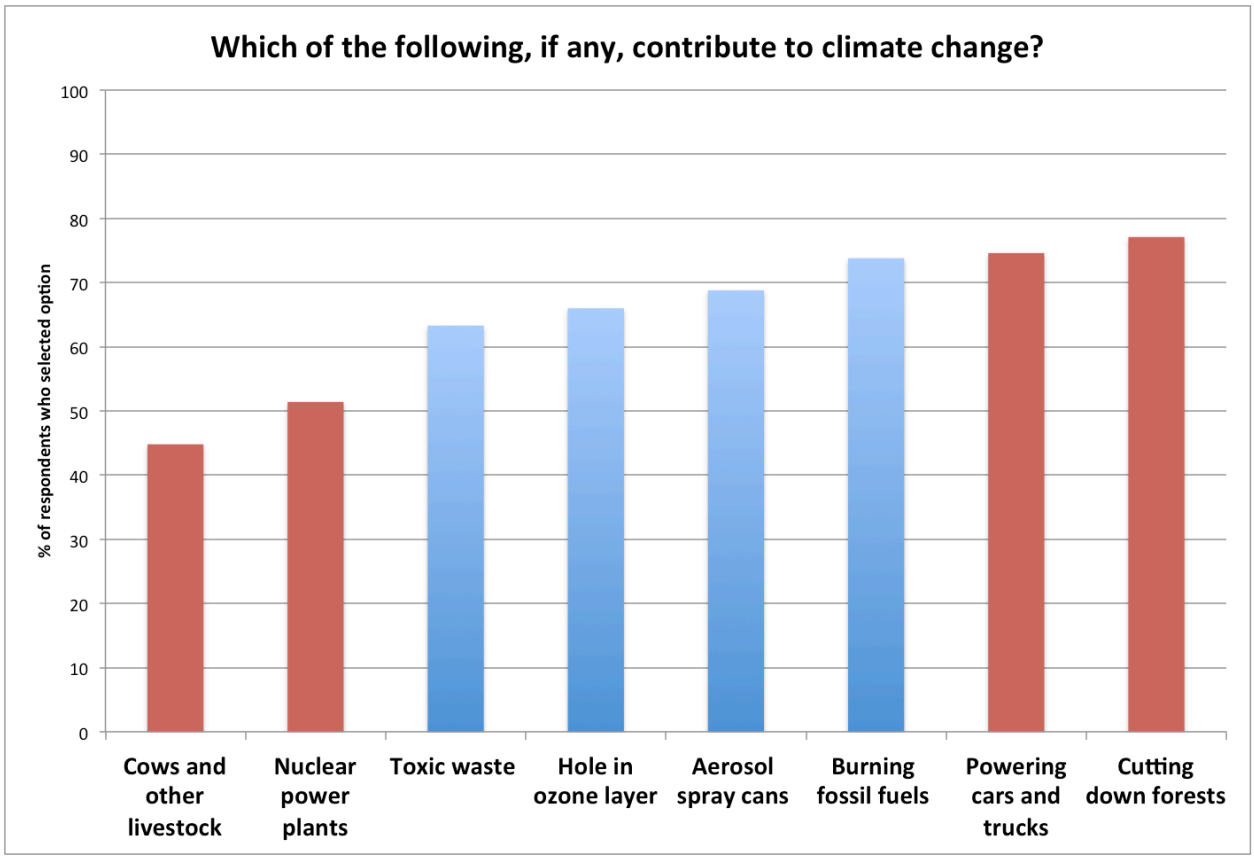
Figure 1: Percentage of Respondents Who Selected Each Impact



However, it seems as though there is some confusion as to the causes of climate change (Figure 2). While over 70% of respondents identified burning fossil fuels, power cars and trucks and cutting down forests as causes of climate change, the majority also selected 'bogus' causes. For instance, almost 70% thought that aerosol spray cans contribute to climate change. While aerosols and the hole in the ozone layer are both significant within the context of the environment, neither factor is directly related to climate change. Furthermore, 51.4% selected nuclear power as a cause of climate change, but in reality increased nuclear power generation would actually help to mitigate climate change because it does not emit GHGs. Finally, the majority (55.2%) of respondents did

not recognize that livestock contributes to climate change despite the fact that this is a significant source of methane (FAO, 2015).

Figure 2: Percentage of Respondents Who Selected Each of the Possible Causes of Climate Change



Red bars correspond to "incorrect" answers (i.e. factors that do not directly and/or significantly contribute to climate change, blue bars correspond to correct answers. Respondents could select as many of the above options as they choose

The last variable that was examined is risk perception. Overall, people had a fairly low to moderate perception of risk toward climate change with an average score of 6.4 out of a maximum of 25 (Table 6). Of the 362 individuals included in this analysis, not a single person exhibited the highest (25) or second highest (20) possible levels of risk perception. In contrast, 14.4% thought of climate change as not at all risky (score of 1). The risk perception measure was made up of a vulnerability and a severity perception

item with the average vulnerability score (2.48 out 5) being slightly higher than the average severity score (2.33). Table 7 shows the breakdown of how participants perceived both their personal risk and severity.

Table 6: Risk Perception Total

Risk Perception Score	Percentage of Respondents
(Low) 1	14.4
2	6.6
3	1.1
4	24.9
5	0.3
6	13.3
(Moderate) 8	2.2
9	21.3
12	8.6
15	2.2
(High) 16	5.2
20	0
25	0

Table 7: Risk Severity and Vulnerability

	Percentage of respondents	
Perceived Risk (score)	**Severe**	**Vulnerable**
Not at all	21[a]	15.7[b]
Slightly	34.8	37
Moderately	34.8	32.9
Very	8.8	12.4
Extremely	0.6	1.9

[a]Corresponds to the percentage of respondents who thought the effects of climate change will be "not at all severe" for them personally

[b]Corresponds to the percentage of respondents who thought they were "not at all vulnerable" to the effects of climate change

2.6b Reliability Testing

The 3 items included in the environmental values measure had a Cronbach's Alpha of .902 (Table 8), which is above .7, therefore, making it a reliable measure

(Pallant, 2013). The Cronbach's Alpha for the two risk perception items was .826, which also indicated good internal consistency.

Table 8: Reliability Testing Results

Latent Variable	Item	Chronbach's Alpha	Alpha if item deleted
Values		.902	
	Protecting the environment, preserving nature		.867
	Fitting into nature, unity with nature		.879
	Respecting the earth, harmony with other species		.837
Risk Perception		.826	
	How severe do you think the effects of climate change are/will be for you personally		
	How vulnerable to do feel to the effects of climate change		

2.6c Bivariate Correlations

Correlations between the three independent variables, socio-demographic variables, and the dependent variable (behavior) were run to serve as an initial test of the hypotheses. Table 9 shows correlations for all of the tested relationships. A correlation is considered strong if the Pearson's r-value is between 0.5-1, moderate between 0.30-0.49 and weak between 0 and 0.29, this applies to both positive and negative relationships (Cohen, 1988). Accordingly, there was a positive, but weak, relationship between both knowledge and behavior (.229) and values and behavior (.296), which supports hypotheses 1 and 2. There was also a weak, positive correlation between risk perception and behavior (.221), thus providing support for H3, but not H4.

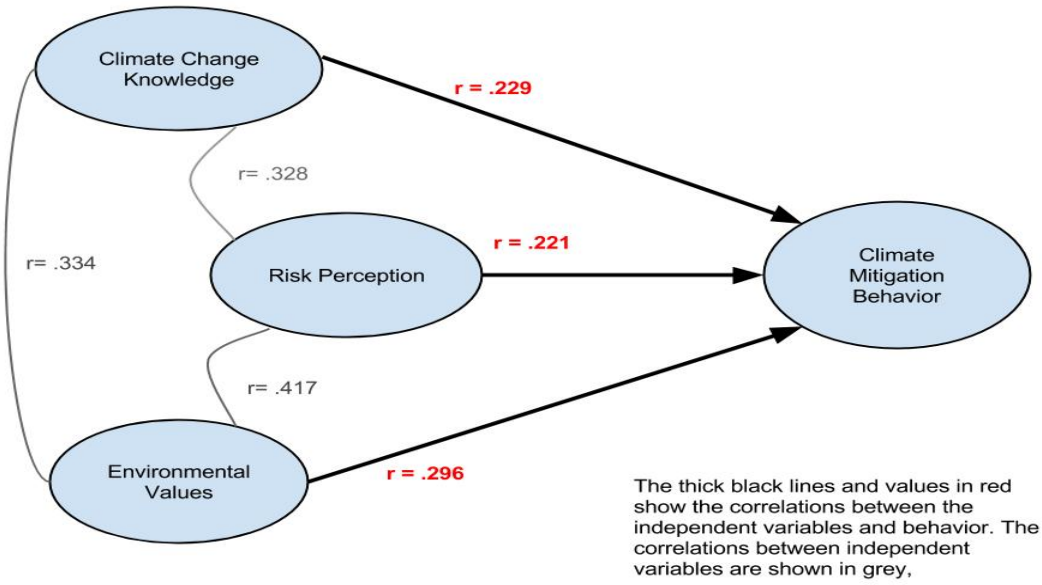
There was a moderately strong positive correlation between values and risk perception (.417), knowledge and risk perception (.328), and values and knowledge

(.334). These results provide some initial support for H5, but do not serve as a complete test of mediation. Figure 3 summarizes the correlations between the main independent variables and behavior. Another correlation worthy of mention was the moderately negative relationship between political orientation and risk perception; as political orientation become more conservative, risk perception decreased, a finding consistent with past literature.

Table 9: Pearson's Correlation Coefficients

Variable	Behavior	RP[1]	Knowledge	Values	Age	Gender	PO[2]	Income	Education
Risk Perception	.221	1							
Knowledge	.229	.328	1						
Values	.296	.417	.334	1					
Age	-.108	-.065	-.040	.033	1				
Gender	.069	.066	-.115	.103	-.109	1			
Political Orientation	-.103	-.305	-.216	-.216	.233	-.119	1		
Income	-.057	-.018	.085	-.005	.264	-.211	.114	1	
Education	.079	.001	.237	-.012	-.018	-.115	-.066	.294	1

Figure 3: Correlations Between Independent and Dependent Variables



2.6d Logistic regression model for climate mitigation behaviors

Due to the fact that the data from the behavior variable was significantly skewed to the left, with the vast majority of respondents engaging in 0 or 1 behavior, responses were recoded to create a dichotomous categorical variable (anyone who engaged in one or more behaviors was assigned the value of one). Logistic regression was used for analysis here because it is most appropriate for a categorical dependent variable. Before running the logistic regression, a multicollinearity test was performed to ensure that none of the independent variables were too highly correlated, which they were not (see Table 10).

Table 10: Multicollinearity Test Results

Model	Tolerance[1]	VIF
Values	.783	1.278
Knowledge	.845	1.183
Risk Perception	.786	1.2724

1- A tolerance value lower than 0.1 indicates that the variables are highly correlated (Pallant, 2013)

The analysis was completed using two blocks with age, gender, income, political orientation, and education in block one and the three independent variables (knowledge, values and risk perception) in block two. Block 0, with none of the variables included, was able to correctly classify 58.3% of cases and the socio-demographic variables only added 0.5% to the model's predictive ability (58.8% total for block 1). Block 2 correctly classified 67.7% of cases, which is a 9.4% improvement over block 0

The final model satisfied the Omnibus Tests of Model Coefficients with a significant value of .000 (Chi-square=50.646 df=8). It also passed the Hosmer and Lemeshow Test with a significant level of .251 (Chi-square=10.206 df=8). According to the analyses, the model was able to explain between 13.1% and 17.6% of variance in

behavior (Cox & Snell R Square=.131, Nagelkerke R square=.176). The sensitivity of the model, which explains how well (for what percentage of people) the model predicted behavior engagement (value of 1), was 80.6%. Specificity was 49.7%, which means that the model correctly predicted 49.7% of the people who did not engage in any of the behaviors (value of 0).

Based on the results presented in Table 10, knowledge and values are the only variables that were significant predictors of behavior in the model (Pallant, 2013). For every one-unit increase in a person's level of knowledge, the likelihood that he/she engaged in one of the climate mitigation behaviors increases by a factor of 1.099 (the EXP(B) value) with a 95% confidence interval of 1.004-1.203. The EXP(B) for environmental values was 1.686 with a 95% confidence interval of 1.290-2.205, which means that an individual is approximately 1.686 times more likely to have engaged in one of the mitigation behaviors for each one-unit increase in the strength of environmental values.

Table 11: Results of the Logistic Regression Model

							95% C.I.for EXP(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
[a]Political Orientation	.093	.105	.788	1	.375	1.098	.893	1.349
Education	.111	.076	2.143	1	.143	1.118	.963	1.297
Income	-.100	.090	1.237	1	.266	.905	.759	1.079
Age	-.014	.008	2.968	1	.085	.987	.972	1.002
Gender	.178	.240	.549	1	.459	1.195	.746	1.914
Knowledge	.095	.046	4.222	1	.040	1.099	1.004	1.203
Values	.523	.137	14.592	1	.000	1.686	1.290	2.205
Risk Perception	.052	.032	2.595	1	.107	1.053	.989	1.121
Constant	-1.746	.864	4.088	1	.043	.174		

2.6e Mediation test using the PROCESS method

I used version 2.13 of the PROCESS macro software to examine if risk perception mediated the relationship between values/knowledge and behavior (Hayes, 2014). Behavior was used as the Outcome Variable (Y) and risk perception was the M (mediating) variable. Running the analysis with knowledge as the independent variable (X) indicated that knowledge is a significant predictor of risk perception (coeff=.4909, p=.0000) and both knowledge (coeff= .1328, p=.0015) and risk perception (coeff= .0864, p=.0029) significantly predict behavior. The model provides support for a small, but significant indirect effect of knowledge, as mediated by risk perception, on behavior. It is significant because the bootstrap confidence interval does not include 0 (BootLLCI=.0141 BootULCI=.0764). However, the direct effect of knowledge on behavior (.1328) is much greater than the indirect effect (.0424).

The environmental values independent variable was also found to be a significant predictor of risk perception (coeff-1.7724, p<0.001). Additionally, risk perception (coeff=.0643, p=.0333) and values (coeff=.5372, p=.0000) significantly predicted behavior. The model showed a significant, though small, indirect effect of values on behavior with risk perception as the mediator (BootLLCI=.0101 BootULCI=.2222). Once again, the direct effect of values on behavior (.5372) was much greater than the indirect effect (.1141). Table 12 summarizes the results of the mediation model.

Table 12: Results from Mediation Test Using PROCESS Method

Variable	Direct Effect	Indirect Effect	Total Effect
Knowledge	0.1328	0.0424	0.1711
Values	0.5372	0.1141	0.6438

2.7 Discussion and Conclusion

This study aimed to accomplish two goals: to assess the level of knowledge Columbus residents have about the causes and effects of climate change and to examine the role that three psychological factors (knowledge, values and risk perception) have in influencing behavior. The existing research indicates that all three psychological factors can play an important role in determining behavior, but they are not equally significant (Dietz et al., 2005; Kollmuss & Agyeman, 2002; Semenza et al., 2008). Furthermore, surveys of the American public suggest that we have, on average, only a very general understanding of climate change (Leisorowitz et al., 2010).

The sample of Columbus residents included in this study had a level of knowledge regarding climate change that is fairly consistent with that of the general American public (Leisorowitz et al., 2010). The majority of respondents selected the correct definition of the greenhouse effect, which means that they can at least identify the basic scientific process governing global warming. Also, most people were able to identify both temperature and extreme weather changes as potential impacts of climate change. This ability to recognize the more 'obvious' impacts of climate change is consistent with findings from previous national surveys (Leisorowitz et al., 2010). However, more complex concepts, such as snow precipitation, crop yields and public health effects, were less frequently identified as things that would be impacted by climate change.

The most problematic knowledge question for the sample was the one that addressed the causes of climate change. For this question, the most frequently selected cause of climate change was cutting down forests. While deforestation is certainly a

significant contributor to climate change, the effect of burning fossil fuels is much more substantial, yet, fewer respondents selected fossil fuels as a cause (U.S. Environmental Protection Agency, 2013b). This is important because the issue of deforestation is typically much further removed from the average American than that of fossil fuel consumption and/or transportation. This difficulty in recognizing the role of one's everyday actives in causing climate change has been found in other studies (McDaniels et al., 1996).

Furthermore, less than half of respondents were able to correctly identify cows and livestock as a cause of climate change, while a majority selected at least one of the bogus causes (nuclear power plants, toxic waste, the hole in the ozone layer and aerosol spray cans), a finding that is consistent with other studies (Leisorowitz et al., 2010). Even though most of the respondents were able to pick at least one correct cause, the frequency with which incorrect causes were selected indicates that the individuals may not have a very clear idea of the actual causes of climate change and which factors are most important. People need to be able to make the connection between the causes and effects of climate change because one's own behavior is often a contributing factor. Therefore, it makes sense that this specific knowledge of the causes and effects of climate change is often more strongly related to behavior than other types of knowledge (Bord et al., 2000).

Although knowledge is not always a strong predictor of behavior, it was a significant factor in the regression model, thus supporting H1. In fact, the effect of knowledge was even stronger than predicted. This is probably due, in part, to the fact that the knowledge variable measured more objective knowledge of the causes and effects of climate change, rather than self-reported knowledge or more belief-based knowledge,

which can be skewed by factors like political orientation (McCright &Dunlap, 2011). Additionally, it could be that accurate knowledge of the causes of climate change means that the person also has a better understanding of which behaviors are most impactful, making him/her more likely to engage in said behavior(s). Contrary to expectation, the effect of knowledge on behavior was not highly mediated through risk perception. However, bivariate correlations and the PROCESS method did show that knowledge is highly related to risk perception. This means that as knowledge increased, so did risk perception of climate change and behavioral engagement, but risk perception did not fully (or mostly) mediate the effect of knowledge on behavior, contrary to H5.

However, there could be other variables that were not included in the analyses that mediated the relationship between knowledge and behavior. It may be that people with higher levels of knowledge were actively seeking out information that pertained to climate change because of their beliefs or some other factor that was not tested here. But, even if there was another unknown variable playing a role, we can at least conclude that knowledge is positively related to climate change mitigation behavior, though it cannot explain all, or even most, of the variance in behavior.

The psychological factor that I found to be most strongly related to behavioral engagement in this group of Columbus residents was environmental values (H2). Consistent with previous research, engagement in climate mitigation behaviors was more common in individuals with strong environmental (self-transcendent) values (Dietz et al., 2005; Karp, 1996). While values were more strongly related to behavior than knowledge or risk perception, they were still only weakly to moderately correlated with behavior. Therefore, individuals did not always act in accordance with their values, which supports

the theory of the value-action gap (Lorenzoni et al., 2007). The PROCESS analysis revealed that while values are a significant predictor of both risk perception and behavior, risk perception plays only a very small mediating role. Consequently, the direct effect of values on adoption of mitigation behaviors was much higher than its indirect effect, which contradicts H5.

Based on the existing literature, I hypothesized (H4) that risk perception toward climate change would be the single largest predictor of mitigation behavior (Semenza et al., 2008; Whitmarsh, 2008). However, this did not prove to be the case. In the regression model, risk perception was the only variable of the three main independent variables that was not a significant predictor, in contradiction of hypothesis 3. Furthermore, risk perception did not act as an important mediator between knowledge/values and behavior (H5). This latter finding was also contrary to expectation because past studies have found that risk perception can help to bridge both the knowledge-action and value-action gaps (Whitmarsh, 2008; Whitmarsh et al., 2011). While the mediating effect of risk perception was quite weak, both knowledge and values were significant predictors of risk perception.

There are several possible reasons as to why risk perception failed to be a strong predictor of behavior. First, the risk perception measure was strongly skewed to the left. The highest possible value (corresponding to the highest perceived risk) for risk perception was 25 and the second highest was 20. Of the 362 respondents included in the analysis, the highest risk perception value was only a 16 and that was still a small percentage of the sample (5.2%). Overall, it would appear that these Columbus residents are not very concerned about climate change, which is in keeping with results from

nationwide surveys (Jones, 2014; Riffkin, 2014). This is likely due to the fact that climate change is seen as both a spatially and temporally distant issue (Lorenzoni et al., 2007). The risk perception questions on the survey asked participants about how severe they thought climate change would be for them personally and how personally vulnerable they feel to the impacts of climate change. Overall, respondents had a higher perception of risk toward their personal vulnerability to the impacts of climate change than they did toward the personal severity of the impacts. This indicates that even if people think they are susceptible to climate change impacts, they do not necessarily think the impacts will be very bad for them personally. The fact that the fewest number of respondents selected 'human and health and safety' as an impact of climate change (out of the six options) supports the theory that climate change is psychologically distance and, consequently, perceived as relatively low risk.

Additionally, biases within the sample itself may partially help account for the overall low risk perception. For instance, the sample was more highly educated than Columbus residents as a whole and past research has found higher education and income are inversely related to risk perception (Slovic, 1999). Additionally, both men and Caucasians were overrepresented in the sample, which could mean that the 'White-male effect' is contributing to lower levels of risk perception (Slovic, 1999). It is also worth noting here that risk perception was negatively correlated with political conservatism and over half the respondents (52.1%) identified as conservative leaning. Thus, it is possible that political conservatism played a role in the low levels of risk perception.

On the whole, the entire regression model was able to explain between 13.1-17.6% variance in behavior, most of which was predicted by knowledge and, especially,

values; sociodemographic variables did not significantly add to the predictive ability of the model. Additionally, the model was much more effective at predicting positives (behavior engagement) than negatives (not engaging in any of the behaviors). One possible explanation as to why the model, specifically with respect to risk perception, failed to account for a greater amount of variance may have to do with the behaviors that the survey measured. While washing clothes with cold water and driving less often are both behaviors that conserve energy and decrease emissions, people often engage in these behaviors for reasons outside of mitigating climate change. Of the three behaviors listed, contacting one's state representative about addressing climate change was the only behavior that a person must engage in with the explicit intent of doing something related to climate change; this is probably why the number of people who reported contacting their representative was so small.

Another noteworthy finding from this study was that the relationship between knowledge/values and risk perception was much stronger than the connection between risk perception and behavior. This was demonstrated through both the bivariate correlations and the mediation analysis. So, while greater knowledge of climate change and stronger environmental values may lead to higher perception of risk, this risk perception is not translating into behavior. The disconnect may not be because risk perception is a poor predictor of behavior, but, rather, because climate change does not even register as a risk for many people in Columbus. Even though this sample of Columbus residents apparently had a basic understanding of climate change and reportedly value the environment, most respondents were not extremely engaged with the issue of climate change. This is evidenced by the fact that risk perception toward climate

change was so low and by the fact that so few people were engaging in more than one of the mitigation behaviors (about 15% doing 2 or 3 of the behaviors).

Including more than those three behaviors and/or assessing whether the behaviors were being carried out with the intention of addressing climate change could have increased the variation within and strength of the risk perception measure, which is something I would recommend doing in future studies. Doing so may also help address the skewed nature of the behavioral measure. Due to the fact that the vast majority of respondents engaged in zero or one of the behaviors, it made sense to treat it as a categorical variable and use logistic regression. Unfortunately, this caused the measure to lose much of its variation because people who engaged in two or all three behaviors were treated the same as someone who only engaged in only one. Another noteworthy limitation was that self-efficacy was not included in the analyses. Efficacy is very much related to risk perception and thought to be an important precursor to behavior (Milfront, 2012). Including it in the model or testing its mediating effect on risk perception could have helped explain the weaker than expected relationship between risk perception and behavior.

Despite the limitations of this study, the results still provide some useful insight into what Columbus residents know and believe about climate change. Based on this information, I can provide some general recommendations for communicating with the Columbus public about climate change. First of all, any effort designed to increase knowledge should focus on the causes and effects of climate change, and stress which causes contribute the most and address the most common misconceptions. Discussing the actions that are the largest contributors to climate change is particularly important

because it helps people realize that they can make a difference. For instance, providing information about how personal automobiles contribute to climate change, while also suggesting ways to decrease this impact and provide personal benefits (cleaner air, saving money) is an effective way to explain both causes and effects in a personally relevant manner.

Furthermore, the strength of the relationship between values and behaviors suggests that a values-based appeal could be effective. For example, a communicator could target individuals with strong self-transcendent values by emphasizing how climate change will impact all plants, animals and humans, but will disproportionately affect those of lower socio-economic status. However, it is important to design communications that appeal to people on both sides of the value spectrum because communicators tend to focus on self-transcendent values while alienating those with self-enhancement values. Stressing the personal and economic benefits that come from climate change mitigation is one possible way to reach those with stronger self-enhancement values.

The weak relationship between risk perception and behavior does not mean that efforts to increase risk perception toward climate change are in vain. But, more research should be conducted to assess the effectiveness of fear appeals and see whether increasing risk perception, as it relates to the personal negative impacts of climate change, will help increase behavioral engagement in Columbus.

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